HSR Health Services Research

DOI: 10.1111/j.1475-6773.2011.01318.x
RESEARCH ARTICLE

The Effects of Safety Net Hospital Closures and Conversions on Patient Travel Distance to Hospital Services

Gloria J. Bazzoli, Woolton Lee, Hui-Min Hsieh, and Lee Rivers Mobley

Objective. To examine the effects of safety net hospital (SNH) closure and for-profit conversion on uninsured, Medicaid, and racial/ethnic minorities.

Data Sources/Extraction Methods. Hospital discharge data for selected states merged with other sources.

Study Design. We examined travel distance for patients treated in urban hospitals for five diagnosis categories: ambulatory care sensitive conditions, referral sensitive conditions, marker conditions, births, and mental health and substance abuse. We assess how travel was affected for patients after SNH events. Our multivariate models controlled for patient, hospital, health system, and neighborhood characteristics.

Principal Findings. Our results suggested that certain groups of uninsured and Medicaid patients experienced greater disruption in patterns of care, especially Hispanic uninsured and Medicaid women hospitalized for births. In addition, relative to privately insured individuals in SNH event communities, greater travel for mental health and substance abuse care was present for the uninsured.

Conclusions. Closure or for-profit conversions of SNHs appear to have detrimental access effects on particular subgroups of disadvantaged populations, although our results are somewhat inconclusive due to potential power issues. Policy makers may need to pay special attention to these patient subgroups and also to easing transportation barriers when dealing with disruptions resulting from reductions in SNH resources.

Key Words. Safety net hospitals, access to care, racial/ethnic disparities

Safety net hospitals (SNHs) play a critical role in the U.S. health system (Hadley and Holahan 2003; Hadley et al. 2008). These hospitals either have a legal mandate to accept all patients or are private hospitals serving a disproportionate number of indigent individuals (Institute of Medicine, Committee on the Changing Market, Managed Care, and the Future Viability of Safety Net Providers 2000). SNHs are often located in neighborhoods where the poor and

racial and ethnic minorities tend to reside, due to policy decisions to locate facilities in these areas or the locational choices of poor individuals (Gaskin and Hadley 1999; Hadley and Cunningham 2004).

The growing number of the uninsured has created an increased strain on the safety net, largely because it has been stagnant even as the demand for its services has grown (Marquis, Rogowski, and Escarce 2004; Cunningham, Bazzoli, and Katz 2008). Although most communities have stable safety nets (Felland et al. 2003), some have experienced SNH closure or ownership conversions where the expectation of community service is no longer present (e.g., conversion to for-profit status). These events could have a major impact on uninsured and poorly insured individuals who rely on these institutions.

The primary objective of our study was to examine changes in patterns of care within and across communities to assess how SNH closures or for-profit conversions affected disadvantaged individuals who lived near these events. Our difference-in-difference approach accounts not only for changes to local safety nets but also for changes to the overall hospital industry. From a policy perspective, our research is important given continuing public sector budget problems. The economic downturn has hurt state tax revenues, which could affect support for Medicaid and indigent health programs. Although U.S. health reform law may alleviate some issues, expansions of insurance coverage will not be implemented until 2014, and public agencies and SNHs will need to cope with growing numbers of uninsured in the interim.

BACKGROUND ON PRIOR RESEARCH

Many studies have examined how use of health services varies across individuals based on their insurance status and race/ethnicity. Generally, these studies documented substantial disparities for high-tech services and cardiac

---

Address correspondence to Gloria J. Bazzoli, Ph.D., Bon Secours Professor of Health Administration, Department of Health Administration, Virginia Commonwealth University, P.O. Box 980203, Richmond, VA 23298-0203; e-mail: gbazzoli@vcu.edu. Woolton Lee, Ph.D., Research Fellow, is with the Department of Healthcare Policy and Research, Virginia Commonwealth University, Richmond, VA. Hui-Min Hsieh, Ph.D., Assistant Professor, is with the Department of Public Health at Kaohsiung Medical University, Kaohsiung, Taiwan. Lee Rivers Mobley, Ph.D., Senior Research Fellow in Health Economics, is with the RTI International (Research Triangle Institute), Research Triangle Park, NC.

disease, cancer, and referral-sensitive conditions (Shavers and Brown 2002; Shavers, Harlan, and Stevens 2003; Cromwell et al. 2005; Jha et al. 2005). Other studies examined disparities in hospitalizations for preventable ambulatory care sensitive conditions (Gaskin and Hoffman 2000; Weinick, Zuvekas, and Cohen 2000). Spillman, Zuckerman, and Garrett (2003) and Holahan and Spillman (2002) examined the effects of the presence of a public hospital or a community health center in an individual's county and found that these facilities had little impact on access to care for the poor. Hargraves and Hadley (2003) found little impact of safety net resources on observed racial/ethnic disparities.

Gresenz, Rogowski, and Escarce (2007) and Hadley and Cunningham (2004) both examined how distance to safety net providers affected access to care and service use among uninsured individuals. Gresenz, Rogowski, and Escarce (2007) found that nearby safety net resources, particularly the number of hospital emergency departments and public hospitals, had modest positive effects on service utilization for the urban uninsured. Hadley and Cunningham (2004) found that shorter distances to the nearest safety net provider had positive effects on access to care for the uninsured. Our study builds primarily on these latter two studies by examining how the decline in SNH resources in a community affects the distance traveled by patients for their hospital care. Our findings, in conjunction with these earlier studies, provide a more complete picture of the importance of SNHs to underserved populations.

CONCEPTUAL FRAMEWORK

Dranove, White, and Wu (1993) and White and Morrisey (1998) examined patient travel distance, characterizing it within the framework of consumer search decisions and hospital choice. The primary determinants of distance in their models included travel costs, information costs, and gains from consumer search. Their models suggest that patients prefer to receive care at the nearest hospital, ceteris paribus. However, hospitals farther away could provide sufficient benefits to offset additional travel costs, especially if only certain hospitals provide particular services or if they are perceived as higher quality. White and Morrisey (1998) also noted that anticipated gains from consumer search may be greater for certain types of care, such as highly technical or specialized services. Routine procedures may not exhibit similar gains and, for emergency care, there may be substantial losses associated with longer travel. White and Morrisey (1998) also noted that the type of

insurance coverage may affect travel. Individuals enrolled in managed care plans may have lower information costs if their health plans report provider performance data and if they selectively contract with certain facilities.

Mobley and Frech (2000) also examined patient travel distance. Overall, their conceptual model suggested that patient travel distance depends on patient characteristics, which affect perceived travel costs and benefits; hospital characteristics that affect the gains from travel; community characteristics that may complicate travel; and intervening hospital alternatives, which may affect the benefits from travel.

The Impact of Safety Net Hospital Closure or For-Profit Conversion

Safety net hospitals serve a variety of patients in their local communities, not just the uninsured and Medicaid patients but also individuals with private health insurance and Medicare. Patients choose these facilities for a variety of reasons. SNHs may be the nearest facility to their homes and thus represent the lowest travel cost option for a patient. SNHs also have historically provided an array of services not commonly offered by non-SNHs and thus may be one of few available institutions meeting certain patient needs (Zuckerman et al. 2001; Bazzoli et al. 2005; Horwitz 2005). When SNHs close or convert to an ownership status that does not obligate community service, these changes will affect those individuals who rely most on these facilities. Although all patients, whether insured or uninsured, near these facilities might be affected, the uninsured and Medicaid patients may experience a differentially greater impact because finding an acceptable alternative facility may be more difficult for them.

Differential effects may also be present across patient diagnosis categories. For patients with emergent health needs, the closure of a nearby SNH will likely have similar effects on travel for all patients, regardless of their insurance status. However, for specialized or referral sensitive care, uninsured and Medicaid patients may require more distant travel to locate physicians and facilities willing to treat them. For more routine care, including ambulatory care sensitive conditions or births, there may be more hospital options nearby.

Overall, the conceptual framework leads us to hypothesize that the uninsured and Medicaid patients living near an SNH that closes or converts are likely to have their travel patterns most adversely affected by these events. This adverse effect should be apparent when we look across communities and compare travel for uninsured and Medicaid patients living near SNH events

to individuals with similar insurance status in communities without SNH changes. Likewise, differential effects on travel should be apparent when we compare the uninsured and Medicaid patients to the privately insured, all of whom live in a community near a SNH event. Travel effects may be more pronounced for racial/ethnic minorities and may vary by patient diagnosis.

METHODS

The primary data came from the Agency for Healthcare Research and Quality (AHRQ) Healthcare Cost and Utilization Project (HCUP) State Inpatient Databases (SID) for the states of Arizona, California, Florida, and Wisconsin. These states were selected because they had mandatory reporting of discharge data and have complete data on patient race/ethnicity, zip code of residence, and insurance status. Because the timing of the availability of certain study variables was different for each state, we had to examine different study periods. Our base and ending year for Arizona were 1995 and 2003, for California were 1990 and 2000, for Florida were 1992 and 2003, and for Wisconsin were 1992 and 2003.

AHA Annual Survey data allowed us to identify and track SNHs over time and to determine whether they closed or converted to for-profit status. These data also included information on hospital characteristics that may affect patient preferences and to identify the availability of nearby alternative hospitals. AHA hospital data were linked to the SID primarily through the AHA identification number, which AHRQ merges into most state SID files. For California, we used a crosswalk of the AHA identification numbers and state-specific identification numbers.

Other study data included the U.S. Census and the Area Resource File, which provided information on community characteristics. The Census data in 2000 were available at the zip code tabulation area (ZCTA) level, and we used the ZCTA footprints to build a crosswalk to the 1990 Census zip code-level data. The 1990 Census data were matched with the base year observations and the 2000 data matched with the ending year observations. Area Resource File data were merged by county code.

We restricted our analysis to patients treated at urban hospitals (located in Metropolitan Statistical Areas). Patient travel to rural hospitals presents an array of challenges affected by hospital and specialist service availability, institutional capacity, perceptions of provider quality, and referral considerations that were beyond the scope of our study (Liu, Bellamy, and McCormick 2007).

Identification of Safety Net Hospitals

Researchers have used various methods to identify SNHs, with some focusing exclusively on public hospitals (Marquis, Rogowski, and Escarce 2004), others on public hospitals and academic medical centers (Baxter and Mechanic 1997; Fishman and Bentley 1997), and still others using hospital data on uncompensated or Medicaid care to assess hospital safety net involvement (Cunningham and Tu 1997; Zuckerman et al. 2001; Bazzoli, Manheim, and Waters 2003; Bazzoli et al. 2005). Gaskin, Hadley, and Freeman (2001) and Hadley and Cunningham (2004) blended these various approaches, focusing primarily on public hospitals and a select group of nonprofit hospitals with disproportionate provision of care to Medicaid patients. They used the state mean of urban nonprofit hospital Medicaid patient share plus one standard deviation as a threshold to identify nonprofit SNHs.

Following their approach, we computed a 2-year average of Medicaid share of inpatient days for the base year and year prior using AHA data, and then calculated the mean plus one standard deviation for urban nonprofit hospitals in each study state. Those nonprofit hospitals meeting this Medicaid patient share threshold were deemed SNHs along with all urban public hospitals. All remaining community hospitals were considered non-SNHs.

This approach has weaknesses. First, it does not include care for all indigent patients, in particular the uninsured. Hospital uncompensated care could be examined, but publicly available data on this measure only became available in 2003. Second, hospitals with high Medicaid patient share may have few uninsured patients if these hospitals qualify many indigent patients for Medicaid, but existing evidence suggests that hospitals with high Medicaid patient share also have high uninsured proportions (Zaman, Cummings, and Siegel 2009). Third, there may be instability in Medicaid volume so that hospitals might be SNHs in 1 year but not the next. Although this may happen at the margins (e.g., hospitals near the SNH threshold), Bazzoli et al. (2005), Bazzoli, Manheim, and Waters (2003) found that about three-quarters of SNHs identified using a similar approach were identified as SNHs 3 years later.

In our four study states, we identified 126 SNHs and 495 non-SNHs. By the ending years, 11 of these SNHs (8.7 percent) closed and 8 (6.4 percent) converted to for-profit status. SNHs that closed or converted were more often nonprofit (45.5 percent) than those that remained open (30.2 percent). SNHs that closed or converted tended to have smaller bed sizes (mean of 130 beds) than those that remained operational (mean of 283 beds).

Empirical Model

The following empirical model was examined:

$$\log(d_{ij}) = \beta_0 + \beta_1 \text{pchar}_i + \beta_2 \text{hchar}_{ij} + \beta_3 \text{cchar}_i + \beta_4 \text{hschar}_i + \delta_1 \text{SNH}\Delta_i + \delta_2 \text{SNH}\Delta_i^* \textit{patins}_i + \lambda_i \text{endyr} + \lambda_2 \text{endyr}^* \textit{patins}_i + \varepsilon_{ij} \quad (1)$$

where: d_{ij} equals distance traveled by patient i to hospital j; pchar_i are patient characteristics; hchar_i are hospital characteristics; cchar_i are community characteristics; hschar_{ij} are health system characteristics; and endyr is a dummy indicator for the ending year of study. The latter is interacted with a patient's insurance status to model the changing insurance environment over time. In particular, over our study period, the strength of managed care organizations declined due to the managed care backlash, as did their use of selective contracting in the private sector (Draper et al. 2002), whereas Medicaid managed care became more prevalent, growing from around 14 percent in the early 1990s to 57 percent of enrollees in the early 2000s (Center for Medicare and Medicaid Services 2011). Thus, the influence of payers on patient travel likely changed from the base to ending year of our study period. The effects of SNH closure/conversion are picked up by the direct SNHΔ measure and its interaction with patient insurance status.

This model is estimated separately for five categories of diagnoses: (1) ambulatory care sensitive conditions, (2) referral sensitive conditions, (3) marker conditions, (4) births, and (5) mental health and substance abuse admissions. Ambulatory care sensitive condition admissions are potentially preventable and typically necessitate treatment to stabilize patient health condition. Referral sensitive conditions are hi-tech services typically offered at select hospitals and requiring specialized surgeons. Marker conditions require emergent care and are generally believed to be access insensitive. Approaches developed by Billings, Zeitel, and Lukomnik (1993) and modified subsequently were used to identify these conditions (Appendix Table A). We used patient MDC codes to identify births and mental health and substance abuse admissions. For our analysis of births, we included patients aged 15–44, and patients aged 25 or older for the other diagnoses.

Variable Construction

The variable of primary interest is travel distance to the hospital. We calculated straight-line distance between the centroid of a patient's zip code to the

centroid of the zip code for the hospital.[1] We explored alternative approaches, namely the use of programs to calculate road distance miles or travel times, but these programs reflect current roads, not those in the years studied. Given that travel distance was highly skewed, this variable was logged and a small positive value (0.005) was added to observations in which patients and their selected hospitals were in the same zip code.

We used travel distance data to create thresholds for individuals living near SNH closure/conversion events. The distribution of patient travel distances to each urban SNH and to its nearest five neighboring hospitals was examined for each study state. The 67th percentile travel distance was used as a threshold for living near a SNH, recognizing that most patients select facilities near their homes. The distance thresholds were as follows: 9 miles for Arizona, 7 miles for California, 8 miles for Florida, and 7 miles for Wisconsin.

To measure the effects of SNH closure or for-profit conversion, we added up all SNH beds that were within the mileage thresholds noted above for each patient zip code in the base year. We then calculated the percent of beds affected by SNH closure or for-profit conversion. This was the primary variable we used for SNHΔ in equation 1. We used this instead of a simple 0/1 indicator of SNH closure/conversion because the extent to which SNH capacity was affected by these events varied markedly across communities, from 12.7 to 100 percent with an average of 65.6 percent (Table 3).

State Inpatient Databases data were used to construct patient characteristics, including patient age of 65–79 and age greater than 80 (younger ages were the reference group); race/ethnicity as non-Hispanic white, non-Hispanic black, and Hispanic; insurance status as Medicare, Medicaid, and uninsured (privately insured as the reference group). A count of patient comorbidities was constructed using secondary and higher diagnoses (Elixhauser et al. 1998). An indicator for emergent admissions was also included. Finally, a female gender variable was included in all models except the birth model.

Measures of hospital characteristics included major teaching hospitals identified by being a member of the Association of American Medical Colleges Council of Teaching Hospitals; minor teaching hospitals with resident physician programs but not members of this Council; and the number of tertiary and specialty services (Bazzoli et al. 1999). Hospitals with more than the 75th percentile of this count were identified as high-tech.

Health system characteristics included the number of non-SNH beds within the travel distance thresholds noted above for each patient zip code. Explanatory variables also included the number of primary care physicians

per 1, 000 residents in a county, which may affect ambulatory care sensitive admissions and patient referral for other conditions.

Finally, two measures of community characteristics were included. First, we examined a measure of the percent of the population within a ZCTA that traveled 60 or more minutes to work. This measure reflects the extent of urban sprawl and people's tolerance for long travel in their daily activities. Second, we included population density in the models, which measures a concentrated local population.

Analytical Methods

Data for the base and ending year were combined and model (1) was estimated for each of the five diagnosis categories, one set for all racial/ethnic groups combined and a second by race/ethnic group. All models used robust procedures, recognizing the clustering of several variables in the model.

We explored whether an instrumental variables approach should be used to estimate models instead of ordinary least squares (OLS), which assumes that SNH closures/conversions are exogenous. Instrumental variables included measures of potential need for a local SNH (based on community characteristics) and potential willingness to support a safety net (based on local political voting patterns). Although the instruments passed standard specification tests for their validity (Woolridge 2003), Hausman tests indicated that endogeneity was not an issue.[2] Thus, we strictly conducted OLS analysis given that an instrumental variable would yield inefficient estimates.

We used a difference-in-difference approach with equation (1) to assess whether the uninsured or Medicaid patients were differentially affected by nearby SNH closure or conversion events. This approach has merit in that it nets out the effects of secular trends or local events that took place concurrently with changes in the hospital safety net. In one set of comparisons, we examined how travel distance changed for the uninsured and Medicaid patients living near SNH closures/conversions relative to similar patients in communities where SNHs were stable. A second set of comparisons assessed changes in travel for the uninsured and Medicaid patients living near SNH events relative to the privately insured living in these same communities. Together both sets of comparisons provide different perspectives in assessing how the care of vulnerable populations was affected by nearby SNH events. Changes in travel distance from base to ending year for different groups were calculated using our regression estimates.[3] The Duan (1983) smearing

estimate was used given the logging of the distance variable. Bootstrapping with 100 replications was used to obtain standard errors for the difference-in-difference measures.

FINDINGS

Table 1 reports counts of study observations for each of the admission categories. There were 368,782 (10.7%) patient discharges near the SNH events. For Hispanics, the dominant reason for admission was births. Births and ambulatory care sensitive conditions were major reasons for admission for non-Hispanic whites and non-Hispanic blacks.

Descriptive data on the dependent variable are presented in Table 2. The data indicate that travel distances were significantly shorter in the ending year relative to the base year, regardless of whether patients were near or not near a SNH event. These changes in distance may reflect the greater diffusion of certain services, declining ability of health plans to steer patients to certain facilities, or idiosyncratic changes in zip code definitions. Overall, they indicate the importance of using a difference-in-difference approach to examine effects of SNH changes.

Table 3 presents descriptive information. About 30 percent of the study observations were elderly. Medicare coverage was the dominant insurer, with Medicaid covering about 25 percent of the observations. Non-Hispanic blacks and Hispanics represented about 35 percent of the study observations. As noted above, 65.6 percent—or nearly two-thirds—of SNH beds were affected by the SNH closure/conversion for those living near these events.

Multivariate regressions for the combined sample are reported in Appendix Table B. These models were also estimated by racial/ethnic groups (results available from lead author). The variables of primary interest are those associated with the SNH closure/conversion, but their coefficients are not directly interpretable because they represent partial effects rather than the desired difference-in-difference measures. Generally, the regression estimates for most variables conform to what others have found (Dranove, White, and Wu 1993, White and Morrisey 1998, Mobley and Frech 2000).

Table 4 reports the difference-in-difference estimates of changes in travel distance over the study period. Two sets of comparisons are present. The first set of columns reports changing travel for Medicaid patients or the uninsured across areas with and without SNH changes, and for simplicity, we refer to these as "across area differences." The second set of columns reports chang-

Table 1: Study Observations by Admission Category, Race/Ethnicity, and Community Type

	Located near a Safety Net Hospital Closure or For-Profit Conversion						*Not Located near a Safety Net Hospital Closure or For-Profit Conversion*						
	Non-Hispanic White		*Non-Hispanic Black*		*Hispanic*		*Non-Hispanic White*		*Non-Hispanic Black*		*Hispanic*		
Patients Hospitalized with:	*Number*	*%*	*Number*	*%*	*Number*	*%*	*Number*	*%*	*Number*	*%*	*Number*	*%*	*Total*
Ambulatory care sensitive conditions	82,016	35.7	17,938	34.0	12,793	14.8	765,175	37.2	122,049	37.0	135,205	19.2	1,135,176
Referral sensitive conditions	28,093	12.2	2,501	4.8	2,503	2.9	260,686	12.7	13,041	4.0	22,529	3.2	329,353
Marker conditions	21,791	9.5	1,985	3.8	2,732	3.2	206,857	10.1	14,037	4.3	26,968	3.8	274,370
Births	81,291	35.4	26,211	49.7	66,865	77.3	664,463	32.4	153,607	46.6	497,360	70.6	1,489,797
Mental health and substance abuse admissions	16,427	7.2	4,056	7.7	1,580	1.8	156,259	7.6	27,245	8.3	22,733	3.2	228,300
Total	229,618	100.0	52,691	100.0	86,473	100.0	2,053,440	100.0	329,979	100.0	704,795	100.0	3,456,996

Table 2: Average Travel Distance for Hospital Services for Patients in Different Community Types (standard errors in parentheses)

	Located near a Safety Net Hospital Closure or For-Profit Conversion		*Not Located near a Safety Net Hospital Closure or For-Profit Conversion*	
Travel Distance (in miles) for Patients Hospitalized with:	*Base Year*	*Ending Year*	*Base Year*	*Ending Year*
Ambulatory care sensitive conditions	5.99 (0.08)	5.62** (0.05)	6.79 (0.03)	6.58** (0.02)
Referral sensitive conditions	9.56 (0.18)	8.55** (0.12)	13.45 (0.08)	12.00** (0.05)
Marker conditions	6.14 (0.16)	5.73** (0.12)	7.13 (0.06)	7.00** (0.04)
Births	6.74 (0.04)	6.48** (0.03)	7.83 (0.02)	7.67** (0.01)
Mental health and substance abuse admissions	9.06 (0.22)	8.05** (0.15)	10.33 (0.09)	9.33** (0.05)

**Mean in the ending year is significantly lower than the mean in the base year at the $p < .05$ level.

ing travel for Medicaid patients or the uninsured relative to the privately insured, all of whom live in areas near SNH changes, and we refer to these as "within area differences."

Looking at the across area differences, we observe that there are no significant travel distance changes for the uninsured or Medicaid patients when we compare areas with and without SNH events in the first four diagnosis categories. Nor do these findings suggest a consistent pattern of positive signs, which would be indicative of relatively longer travel for Medicaid patients or the uninsured across the study areas. The across area results do, however, suggest that uninsured women living near SNHs that closed/converted overall did travel 3.29 additional miles in the ending year to give birth relative to similar women in areas without SNH change. But this combines a relative decline in travel for non-Hispanic black uninsured women (−6.19 miles) and a relative increase for Hispanic uninsured women (+5.87). These different effects across minority groups are interesting, suggesting that perhaps uninsured non-Hispanic black women initially bypassed nearer hospital options to get to a preferred SNH, whereas Hispanic uninsured women may have lost SNH resources to which they were more proximate. The across area findings also suggest that Hispanic women covered by Medicaid traveled relatively farther to give birth after nearby SNH changes than their counterparts in areas without these events.

Looking at the within area differences, the results provide more indications that Medicaid and uninsured patients may have been differentially disadvantaged by SNH changes relative to the privately insured who lived

Table 3: Descriptive Statistics on Study Variables

	Located near a Safety Net Hospital Closure or For-Profit Conversion		*Not Located near a Safety Net Hospital Closure or For-Profit Conversion*	
Explanatory Variable	*Mean*	*STD*	*Mean*	*STD*
Patient characteristics				
Proportion with ages 65–79	0.17	0.38	0.20	0.40
Proportion with age 80+	0.11	0.32	0.14	0.35
Proportion female	0.76	0.42	0.74	0.44
Number of comorbidities	0.77	1.06	0.81	1.06
Proportion covered by Medicare	0.31	0.46	0.35	0.48
Proportion covered by Medicaid	0.29	0.46	0.24	0.42
Proportion uninsured	0.03	0.18	0.05	0.22
Proportion non-Hispanic Black	0.14	0.35	0.11	0.31
Proportion Hispanic	0.23	0.42	0.23	0.42
Proportion emergent admission	0.29	0.46	0.30	0.46
Proportion with emergent admission indicator missing	0.25	0.43	0.29	0.45
Hospital characteristics				
High-tech hospital	0.71	0.45	0.61	0.49
Major teaching hospital	0.19	0.39	0.12	0.33
Minor teaching hospital	0.25	0.43	0.19	0.39
Health system characteristics				
Number of non-SNH beds/1, 000 population	67.08	198.11	60.22	118.65
Number of primary care physicians/1, 000 population	36.86	45.37	38.83	46.76
Community characteristics				
Proportion of population in ZCTA traveling 60 or more minutes to work	0.07	0.04	0.08	0.05
Population density (number of ZCTA residents per square mile)	5,250.52	3,575.83	4,923.14	5,892.86
Observation year (%)				
Base year	0.49		0.45	
Ending year	0.51		0.55	
SNH beds affected by closure/for-profit conversion (%)	65.6%		0.0%	
Sample size (#)	368,782		3,088,214	

in their communities. The within area differences indicate that the uninsured traveled relatively farther after SNH events to give birth in comparison to privately insured women, and this was especially true for Hispanic uninsured women. Also, the within area results suggest significant relative increases in travel for mental health and substance abuse admissions, for both non-Hispanic black uninsured and Medicaid patients. The within area

Table 4: Summary of Differential Effects of Safety Net Hospital (SNH) Closure and For-Profit Conversion on Added Miles Traveled by Patients: Overall and Race/Ethnicity Payer Differences (bootstrapped standard errors in parentheses)

	ACSC	*RSC*	*MC*	*MHSA*	*Births*		*ACSC*	*RSC*	*MC*	*MHSA*	*Births*
All race/ethnic groups combined						*All race/ethnic groups combined*					
Medicaid: area with SNH change vs. no change	−0.32 (1.24)	−3.59 (17.38)	0.10 (1.45)	−0.67 (1.44)	0.79 (1.29)	Medicaid vs. privately insured: area with SNH change	1.09 (1.43)	−2.11 (7.56)	2.78 (2.27)	0.43 (2.66)	0.80 (1.38)
Uninsured: area with SNH change vs. no change	−0.89 (1.65)	−2.52 (18.11)	−0.56 (1.99)	1.24 (2.19)	3.29* (1.89)	Uninsured vs. privately insured: area with SNH change	2.07 (1.72)	0.30 (13.92)	2.27 (2.11)	5.14* (2.95)	4.11** (1.88)
Non-Hispanic whites						*Non-Hispanic whites*					
Medicaid: area with SNH change vs. no change	−0.58 (1.43)	−3.70 (46.06)	−0.51 (1.79)	−1.40 (1.93)	−0.95 (1.72)	Medicaid vs. privately insured: area with SNH change	0.77 (1.62)	−3.09 (41.70)	3.62 (2.23)	−0.94 (2.51)	0.26 (1.35)
Uninsured: area with SNH change vs. no change	−0.23 (1.71)	−3.49 (60.40)	−0.82 (2.09)	1.82 (2.69)	1.03 (1.48)	Uninsured vs. privately insured: area with SNH change	2.94* (1.75)	−1.24 (57.37)	1.74 (2.65)	4.30 (3.19)	2.26 (1.44)
Non-Hispanic blacks						*Non-Hispanic blacks*					
Medicaid: area with SNH change vs. no change	−0.71 (2.73)	1.39 (1.94)	−1.47 (3.13)	0.33 (3.01)	−1.84 (2.25)	Medicaid vs. privately insured: area with SNH change	0.45 (2.16)	2.37 (2.50)	−0.54 (3.36)	5.58** (2.78)	−0.48 (2.49)
Uninsured: area with SNH change vs. no change	−3.57 (3.56)	1.38 (5.63)	−0.08 (5.20)	−0.09 (3.15)	−6.19*** (2.49)	Uninsured vs. privately insured: area with SNH change	−2.54 (3.25)	7.12 (6.37)	−1.17 (4.97)	9.24* (5.12)	−4.29 (2.81)
Hispanics						*Hispanics*					
Medicaid: area with SNH change vs. no change	2.14 (2.27)	−4.89 (3.55)	2.46 (2.30)	0.24 (1.80)	2.95* (1.74)	Medicaid vs. privately insured: area with SNH change	2.75 (2.76)	−5.23* (2.83)	1.19 (3.82)	1.91 (2.55)	1.17 (2.46)

continued

Table 4. *Continued*

	ACSC	*RSC*	*MC*	*MHSA*	*Births*		*ACSC*	*RSC*	*MC*	*MHSA*	*Births*
Uninsured: area with SNH change vs. no change	2.86 (2.08)	−0.77 (5.18)	−0.43 (2.55)	0.90 (2.23)	5.87* (3.04)	Uninsured vs. privately insured: area with SNH change	5.37 (3.41)	−0.64 (4.84)	2.06 (3.42)	5.15 (3.81)	5.54** (2.69)

Notes. Difference in difference estimates in this table were calculated by obtaining predictions of travel distance using the multivariate model in Appendix Table B and comparable tables by race/ethnic group. Mileage differences for combined model reflect average differences across all sample observations, holding constant effects of being near a SNH event with loss of 65.6% of SNH beds in community (the mean value) and insurance status. Race/ethnic group results also hold this factor constant. Standard errors are derived from bootstrapping with 100 replications. Duan (1983) non-parametric smearing estimate was used for each distance estimate.

*$p < 0.1$,

***$p < 0.01$, **$p < 0.05$.

ACSC, ambulatory care sensitive conditions; MC, marker conditions; MHSA, mental health and substance abuse; RSC, referral sensitive conditions.

comparisons suggest that Hispanic Medicaid patients had relatively shorter increases in travel distance for referral sensitive conditions when compared to similarly affected privately insured (−5.23 miles) and the reason for this paradoxical finding is unclear. Other than the referral sensitive condition category, most other differential travel estimates for the within area comparisons are positive and sometimes fairly large in value for the uninsured, although large standard errors are present due to high variation in estimates around mean values.

Sensitivity Analysis

We conducted an analysis excluding patient observations where SNH conversions occurred, focusing only on SNH closures. In conversion communities, the capacity of the original hospital is still present and local stakeholders may have required new for-profit owners to continue mission-related activities. For the combined race and ethnic group analysis, the statistically significant findings were identical to those in the analysis that included both SNH closures and conversions.[4] The relative increase in added travel for the uninsured and Medicaid patients was greater when one examined only SNH closures relative to the results in Table 4. However, none of the findings for the racial/ethnic subgroup analysis was significant. This likely reflected growing power issues as we examined a limited number of natural events in smaller subgroups of patients.

DISCUSSION

SNHs have faced increased strain due to financial challenges amidst growing demand for their services (Felland, Felt-Lisk, and McHugh 2004; Cunningham, Bazzoli, and Katz 2008). A potential outcome of severe institutional strain is hospital closure or sale to a new owner. We examined the effects of SNH closure and for-profit conversion, assessing how these events affected travel distances for inpatient care for patients who likely relied most on these facilities. Increased travel distance may have detrimental effects on patients. Buchmueller, Jacobson, and Wold (2006) found that increased travel after local hospital closures resulted in greater numbers of deaths for emergent conditions and greater perceived access barriers among patients.

For the urban areas in the four states we examined, our results suggested that certain groups of uninsured or Medicaid patients may have experienced

greater disruption in patterns of care, especially Hispanic uninsured and Medicaid women hospitalized for births. Also, relative to privately insured individuals in communities with SNH events, the uninsured travel farther to obtain mental health and substance abuse services after these events. Although comparisons of uninsured individuals across communities with and without SNH events suggested that the uninsured in event communities were generally not experiencing relatively greater travel, comparisons with privately insured individuals in SNH event communities suggested greater travel disruption among the uninsured, but some of these latter findings were inconclusive due to large standard errors. Power issues may be a problem given that we are studying natural events that are small in number despite their potential to affect many people.

The lack of significance for many findings may be the result of other factors as well. When SNHs exit or change ownership, the burden of care may be taken up by other hospitals in the community. Our analysis focused on SNHs identified in a base period that subsequently closed or converted and did not consider how this action might have spawned change in local safety nets. This is an important area for future research that should be explored using mixed methods approaches to better understand what happened in communities after SNHs closed or converted, including how and why safety net configurations changed, and how these changes affected access to care among uninsured and Medicaid individuals. Also, when SNH resources decline, some uninsured or Medicaid patients may decide not to seek hospital care. The foregoing of care might be especially pronounced for those uninsured and Medicaid patients with few or no nearby alternatives. This is an important issue that cannot be addressed through our data, which strictly focused on hospitalized patients. Future research using population-based data, especially analysis of cohorts of individuals over time, could provide useful additional insights on access effects of local SNH contractions. Our findings suggest that such research should consider patient service type because changes in care-seeking behavior may depend on whether patients are able to put-off or avoid care (e.g., for referral sensitive conditions, mental health issues) or not (e.g., births).

Our study has important limitations. First, our analysis was limited to four states given data availability. Given diversity in state/local safety net policy and capacity (Hadley and Cunningham 2004; Taylor, Cunningham, and McKenzie 2006; Cunningham 2007), study of different markets, time periods, and access measures is essential. Second, the exit or conversion of an SNH is not a random event and may signal changing needs for SNH services.

Although our instrumental variable analysis indicated that endogeneity was not an issue, one cannot rule out that unobserved factors may affect SNH events and patient travel.

Despite these limitations, our results have important implications for future research and health policy. The relatively longer travel distance we found for births in the uninsured and Medicaid Hispanic population after SNH events is important. As reported in Table 1, births represented over 70 percent of hospital admissions for this ethnic group. The findings of a relative decline in travel distance among pregnant, uninsured black women across communities with and without SNH events is also interesting and worthy of additional study, especially to assess if this might reflect the loss of a preferred, although potentially more distant, hospital option. Additional study of mental health care is worthwhile especially given the fragmented nature of the mental health safety net (Felland et al. 2003; National Council for Community Behavioral Healthcare [NCCBH] 2009, National Alliance on Mental Illness [NAMI] and National Council for Community Behavioral Healthcare [NCCBH] 2008). Future research also needs to explore whether uninsured Hispanics and black individuals are relatively more affected by local SNH events than uninsured white individuals.

Overall, the extension of insurance coverage that will result through the new U.S. health reform law may alleviate access problems for certain subpopulations and improve their access to hospital care. However, the problems of uninsured Hispanics may remain given exclusions of illegal immigrants in the health reform law. Additional analysis to understand the strain on SNHs resulting from particular groups of the uninsured will be important as U.S. health reform is implemented.

ACKNOWLEDGMENTS

Joint Acknowledgment/Disclosure Statement: This research was supported by NIH grant R01 HL082707: *Safety Net Hospitals and Minority Access to Care*, awarded by the National Heart, Lung and Blood Institute of the National Institutes of Health. This article was presented at the 2010 American Society of Health Economics meeting and was benefited by the comments of John R. Bowblis and other attendees of the presentation.

Disclosures: None.

Disclaimers: None.

NOTES

1. In a small percentage of cases, we found that the latitude and longitude of zip code centroids changed markedly from the base to ending year, reflecting the continual redrawing of zip code boundaries. We dropped patients in zip codes where the centroid changed more than 5 miles over time to reduce noise in our measures of patient travel distances.
2. Details on the specific instruments used and the results of specification tests are available from the lead author.
3. The variables used to simulate predictions included the percent of SNH beds affected by the event, dummy variables for Medicaid, uninsured, end year, and interactions among these variables. Values for these variables were fixed, leaving other model covariates at their original values.
4. Results available from lead author upon request.

REFERENCES

Baxter, R. J., and R. E. Mechanic. 1997. "The Status of Local Health Care Safety Nets." *Health Affairs* 16: 7–23.

Bazzoli, G. J., L. M. Manheim, and T. M. Waters. 2003. "US Hospital Industry Restructuring and the Hospital Safety Net." *Inquiry* 40: 6–24.

Bazzoli, G. J., S. M. Shortell, N. Dubbs, C. Chan, and P. Kralovec 1999. "A Taxonomy of Healthcare Networks and Systems: Bringing Order out of Chaos." *Health Services Research* 33: 1683–717.

Bazzoli, G. J., R. Kang, R. Hasnain-Wynia, and R. C. Lindrooth. 2005 "An Update on the Safety-Net Hospitals: Coping with the Late 1990s and Early 2000s." *Health Affairs* 24: 1047–56.

Billings, J., L. Zeitel, J. Lukomnik, T. S. Carey, A. E. Blank, and L. Newman. 1993. "Impact of Socioeconomic Status on Hospital Use in New York City." *Health Affairs* 12: 162–73.

Buchmueller, T. C., M. Jacobson, and C. Wold. 2006. "How Far to the Hospital? The Effect of Hospital Closures on Access to Care." *Journal of Health Economics* 25: 740–61.

Center for Medicare and Medicaid Services. 2011. "*Brief Summaries of Medicare & Medicaid as of November 1, 2002.*" Washington, DC. [accessed on February 4]. Available at http://www.cms.gov/MedicareProgramRatesStats/02_SummaryMedicare-Medicaid.asp

Cromwell, J., N. T. McCall, J. Burton, and C. Urato. 2005. "Race/Ethnic Disparities in Utilization of Lifesaving Technologies by Medicare Ischemic Heart Disease Beneficiaries." *Medical Care* 43: 330–7.

Cunningham, P., G. J. Bazzoli, and A. Katz. 2008. "Caught in the Competitive Crossfire: Safety Net Providers Balance Margin and Mission in a Profit-Driven Health Care Market." *Health Affairs Web Exclusive* 27 (5): w374–82.

Cunningham, P., and H. T. Tu. 1997. "A Changing Picture of Uncompensated Care." *Health Affairs* 16: 167–75.

Cunningham, P. J., 2007. "The Health Care Safety Net: What is It, What Good Does It Do, and Will It Still Be There When We Need It?" *Harvard Health Policy Review* 8 (2): 5–14.

Dranove, D., W. D. White, and L. Wu. 1993. "Segmentation in Local Hospital Markets." *Medical Care* 3 (1): 52–64.

Draper, D. A., R. E. Hurley, C. S. Lesser, and B. C. Strunk. 2002. "The Changing Face of Managed Care." *Health Affairs* 21: 11–23.

Duan, N. 1983. "Smearing Estimate: A Nonparametric Retransformation Method" *Journal of the American Statistical Association*, 78: 605–10.

Elixhauser, A., C. Steiner, D. R. Harris, and R. M. Coffey 1998. "Comorbidity Measures for Use with Administrative Data." *Medical Care* January 36 (1): 8–27.

Felland, L. E., C. S. Lesser, A. B. Staiti, A. Katz, and P. Lichiello. 2003. "The Resilience of the Health Care Safety Net, 1996–2001." *Health Services Research* 38 (1 Pt 2): 489–502.

Felland, L. E., S. Felt-Lisk, and M. McHugh. 2004. *Health Care Access for Low-Income People: Significant Safety Net Gaps Remain.* Issue Brief No. 84, June. Washington, DC: Center for Studying Health System Change.

Fishman, L. E., and J. D. Bentley. 1997. "The Evolution of Support for Safety Net Hospitals." *Health Affairs* 16: 30–47.

Gaskin, D. J., J. Hadley, and V. G. Freeman. 2001. "Are Urban Safety Net Hospitals Losing Low-Risk Medicaid Maternity Patients?" *Health Services Research* 36(Part I): 25–51.

Gaskin, D. J., and J. Hadley. 1999. "Population Characteristics of Markets of Safety-Net and Non-Safety-Net Hospitals." *Journal of Urban Health* 76:351–70.

Gaskin, D. J., and C. Hoffman. 2000. "Racial and Ethnic Differences in Preventable Hospitalizations across 10 States." *Medical Care Research and Review* 57 (Supplement 1): 85–107.

Gresenz, C. R., J. Rogowski, and J. J. Escarce. 2007. "Health Care Markets, the Safety Net, and Utilization of Care among The Uninsured" *Health Services Research*, 42(1 Part 1): 239–64.

Hadley, J., and P. Cunningham. 2004. "Availability of Safety Net Providers and Access to Care of Uninsured Persons." *Health Services Research* 39: 1527–46.

Hadley, J., and J. Holahan. 2003. "How Much Medical Care Do the Uninsured Use, and Who Pays for It?" *Health Affairs Web Exclusive*: w3–81.

Hadley, J., J. Holahan, T. Coughlin, and D. Miller. 2008. "Covering the Uninsured in 2008: Current Costs, Sources of Payment, and Incremental Costs." *Health Affairs Web Exclusive* 27 (5): W399–415.

Hargraves, J. L., and J. Hadley. 2003. "The Contribution of Insurance Coverage and Community Resources to Reducing Racial/Ethnic Disparities in Access to Care." *Health Services Research* 38 (June): 809–29.

Holahan, J., and B. Spillman. 2002. *Health Care Access for Uninsured Adults: A Strong Safety Net is Not the Same as Insurance.* The New Federalism Project of the Urban Institute, Series B, No. B-42, Washington, DC January 2002.

Horwitz, J. R., 2005. "Making Profits and Providing Care: Comparing Nonprofit, For-profit, and Government Hospitals." *Health Affairs* 24 (3): 790–6.

Institute of Medicine, Committee on the Changing Market, Managed Care, and the Future Viability of Safety Net Providers. 2000. *America's Health Care Safety Net: Intact But Endangered*, Washington, DC: National Academy Press.

Jha, A. K., E. S. Fisher, L. Zhonghe, J. Orav, and A. M. Epstein. 2005. "Racial Trends in the Use of Major Procedures among the Elderly." *The New England Journal of Medicine* 353: 683–91.

Liu, J., G. Rm. Bellamy, and M. McCormick. 2007. "Patient Bypass Behavior and Critical Access Hospitals: Implications for Patient Retention." *The Journal of Rural Health* 23 (Winter): 17–24.

Marquis, M. S., J. A. Rogowski, and J. J. Escarce. 2004. "Recent Trends in Geographic Variation in the Safety Net." *Medical Care* 42 (May): 408–15.

Mobley, L., and H. E. III Frech. 2000. "Managed Care, Distance Traveled, and Hospital Market Definition." *Inquiry* 37 (Spring):91–107.

National Alliance on Mental Illness (NAMI) and National Council for Community Behavioral Healthcare (NCCBH), 2008. *Coverage for All: Inclusion of Mental Illness and Substance Use Disorders in State Healthcare Reform Initiatives.* June, Washington, DC: NAMI and NCCBH.

National Council for Community Behavioral Healthcare (NCCBH), 2009. *Healthcare Payment Reform and the Behavioral Health Safety Net: What's on the Horizon for the Community Behavioral Health System: Full Report*, April. Washington, DC: NCCBH.

Shavers, V. L., and M. L. Brown. 2002. "Racial Disparities in the Receipt of Cancer Treatment." *Journal of the National Cancer Institute* 94 (March): 334–57.

Shavers, V. L., L. C. Harlan, and J. L. Stevens 2003. "Racial/Ethnic Variation in Clinical Presentation, Treatment, and Survival among Breast Cancer Patients under Age 35." *Cancer* 97 (January): 134–47.

Spillman, B. C., S. Zuckerman, and B. Garrett. 2003. Does the Health Care Safety Net Narrow the Access Gap?. Assessing the New Federalism Project, Discussion Paper #03-02, April 2003. Washington, DC: Urban Institute.

Taylor, E. F., P. J. Cunningham, and K. L. McKenzie. 2006. "Community Approaches to Providing Care for the Uninsured." *Health Affairs Web Exclusive*, 25 (3): w173–82.

Weinick, R. M., S. H. Zuvekas, and J. W. Cohen. 2000. "Racial and Ethnic Differences in Access and Use of Health Care Services, 1977 to 1996." *Medical Care Research and Review* 57 (Supplement 1): 36–54.

White, W. D., and M. A. Morrisey. 1998. "Are Patients Traveling Further?" *International Journal of the Economics of Business* 5 (2): 203–21.

Woolridge, J. M. 2003. *Introductory Econometrics: A Modern Approach*, 2d Edition. Florence, KY: Thomson-Southwestern.

Zaman, O. S., L. C. Cummings, and S. Siegel. 2009. *America's Public Hospitals and HealthSystems, 2007: Results of the Annual NAPH Hospital Characteristics Survey.* Washington, D.C.: National Association of Public Hospitals and Health Systems.

[accessed on January 8, 2010]. Available at http://www.naph.org/Publications/Characteristics-2007.aspx.

Zuckerman, S., G. J. Bazzoli, A. Davidoff, and A. T. LoSasso, 2001. "How Have Safety Net Hospitals Coped during the 1990s?" *Health Affairs* 20: 159–168.

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.

Table A1: List of Ambulatory Care Sensitive, Referral Sensitive, and Marker Conditions.

Table A2: OLS Multivariate Analysis Results: Combined Race Models.

Please note: Wiley-Blackwell is not responsible for the content or functionality of any supporting materials supplied by the authors. Any queries (other than missing material) should be directed to the corresponding author for the article.